

***Interactive comment on* “Formation and evolution of Tar Balls from Northwestern US wildfires” by Arthur J. Sedlacek III et al.**

Anonymous Referee #2

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In this paper, Sedlacek et al. present a set of measurements and analysis to understand formation and properties of tar balls (TB) in biomass burning plumes on the US. The paper is very well written, and for the most part, clear. Considering the difficulty in extracting specific information on different particles from biomass burning plumes, the papers present a set of very compelling new data on the TB physical properties and their evolution. I, therefore, strongly support the publication of these results, as I think they will be very useful to the community. I only request a few minor clarifications and small changes as discussed next.

General comments:

1. In the abstract, the authors suggest that the index of refraction found for the TBs is $m=1.56-0.02i$, but I did not find this value to be really discussed in the paper. The

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last figure of the paper shows a comparison with different index of refraction values published in the literature. The use of the Chakrabarty et al. and the Hand et al. index of refractions seems to bracket the measured values, but why was the Hand value for $k=0.02$ chosen for the abstract is not clear to me. In addition, which one of the two Chakrabarty et al. values given in table 2 were used in the last figure? My point is that the abstract seems to imply a rather specific index of refraction value, while I think the range between the two works mentioned above probably would be a more realistic assertion.

2. I would consider some small reorganization or at least some referencing to specific sections in some cases where some concepts/quantities are mentioned before an explanation is given on how they are calculated or defined. An example is the TB mass fraction, but I will mention that more directly in the specific comments next.

Specific comments:

- Line 69: is this a commercial impactor?
- Line 76: “had the same qualitative trends. . .”, in what sense? I do not fully understand this statement.
- Line 100: Why is the SP-AMS calibrated with regal black and the SP2 with fullerene? Does it matter that two different types of particles are used for calibration?
- Line 115: “using the laser-off CE = 0.5 as the presumed ambient NR-PM loadings” maybe a verb is missing as in: “using the laser-off CE = 0.5 to calculate the presumed ambient NR-PM loading?”
- Line 125: “enhancement” with respect to the background? How was the background determined?
- Line 171: This is an example of when a concept, I believe, is discussed before it is defined. The question the reader might have is: how was the mass ratio calculated? This is discussed later, but here is confusing. Either postpone this discussion, or define

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the ratio before, or at least refer to the section where the mass ratio is clearly defined. The same issue appears in line 182.

- End of sentence on line 188: I think they refer to figure 6.
- Line 206: I think it would be useful to explain how R is calculated, given that what was measured (at least reported earlier) is the number fraction. To calculate the mass ratio a few assumptions (e.g., the bulk mass density) and different measurement of the soot morphology especially needs to be made, I would guess. Again, this becomes clear below, but here is a bit obscure. I would move the mass ratio definition earlier on, or at least I will clearly refer here to the section where it is defined.
- Line 248: “The results presented here raise the question as to how best to describe TBs.” One “to” too many, I believe.
- Line 274: Maybe refer back to equation 1a so it is clear what the four components are.
- Lines 275-276: It would be good to have error bars associated with the SSA estimates from the measurements. In addition, I guess Mie was used for soot as well, which might underestimate the SSA of that component, although maybe that’s not a real issue owing to the fact that the Mie underestimation is mostly in the scattering.
- Figure 4: y-axis label, “Age” seems an odd term here. I would think “Age” should have dimensions of time, while the quantity plotted is probably dimensionless. Same on the x-axis label of figure 6, although in this case there is the term “photochemical” in front, at least.
- Figure 8: As mentioned earlier, error bars on the measured data (green curve) would help interpret which literature value(s) of the index of refraction is(are) consistent with the measurements. Caption, for Chakrabarty et al. in table 2, are reported two different index of refraction values, which one was used here? In addition, why one or the other?

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